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Indian Standard
SPECIFICATION FOR
SUNSHINE RECORDER

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Indian Standard

SPECIFICATION FOR SUNSHINE RECORDER

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Indian Standard

SPECIFICATION FOR SUNSHINE RECORDER

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 31 January 1974, after the draft finalized by the Meteorological Instruments Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 The sunshine recorder is an instrument for the accurate measurement of the duration of bright sunshine at a place. There are different types of instruments available for this purpose, but the Campbell-Stokes pattern which uses the focussed heat radiation from the sun to burn a trace on a chart is widely used.

0.3 There are three types of Campbell-Stokes pattern sunshine recorders designed for use in the tropical, temperate and polar latitudes. Specifications for the tropical pattern sunshine recorders widely used in India have been drawn up by the India Meteorological Department. To encourage the manufacture of these instruments in the country, the formulation of the Indian Standard for sunshine recorders of the tropical pattern suitable for use all over the country has, therefore, become necessary.

0.4 In the formulation of this standard, due consideration has been given to the requirements laid down by the world Meteorological Organization, Geneva, in addition to the special requirements obtaining in this country.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1950*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard specifies the requirements for the tropical pattern sunshine recorder suitable for use in the latitudes 5°S to 45°N.

*Rules for rounding off numerical values (*revised*).

2. DESCRIPTION

2.1 The sunshine recorder consists of a glass sphere mounted concentrically in a section of a spherical bowl, the diameter of which is such that when the instrument is exposed to the sun's rays, they are focussed sharply on a card held in grooves in the bowl. Three overlapping pairs of grooves are provided in the bowl to take cards suitable for different seasons of the year. The instrument is mounted on a heavy base. The sphere itself is held in position inside a sphere support by sphere centres and sphere axle. The sphere support has, engraved on it, a scale of degrees of latitude from -5° through 0° to $+45^{\circ}$. The sphere support with the glass sphere and bowl can be tilted, adjusted and clamped at such an angle as to suit the latitude of the station. The sharply focussed sun's rays burn a trace on the card which has a time scale printed on it. The length of the burn indicates the period of bright sunshine during the day.

3. MATERIAL

3.1 The base shall be made from good quality marble or similar stone, black or white in colour.

3.2 The sphere shall be made of uniform and well-annealed glass, colourless or of pale yellowish tint.

3.3 The bowl shall be made from tin bronze conforming to IS : 306-1968*.

3.4 The pivots shall be made from brass conforming to grade CuZn30 of IS : 4170-1967†.

3.5 All other parts shall be made from tin bronze conforming to IS : 306 1968*.

4. DIMENSIONS

4.1 The instrument shall have the dimensions indicated in Fig. 1 and 2 and shall conform to the general requirements given in 5.

4.2 The cards to be used with the instrument shall have the properties and dimensions specified in Appendix A.

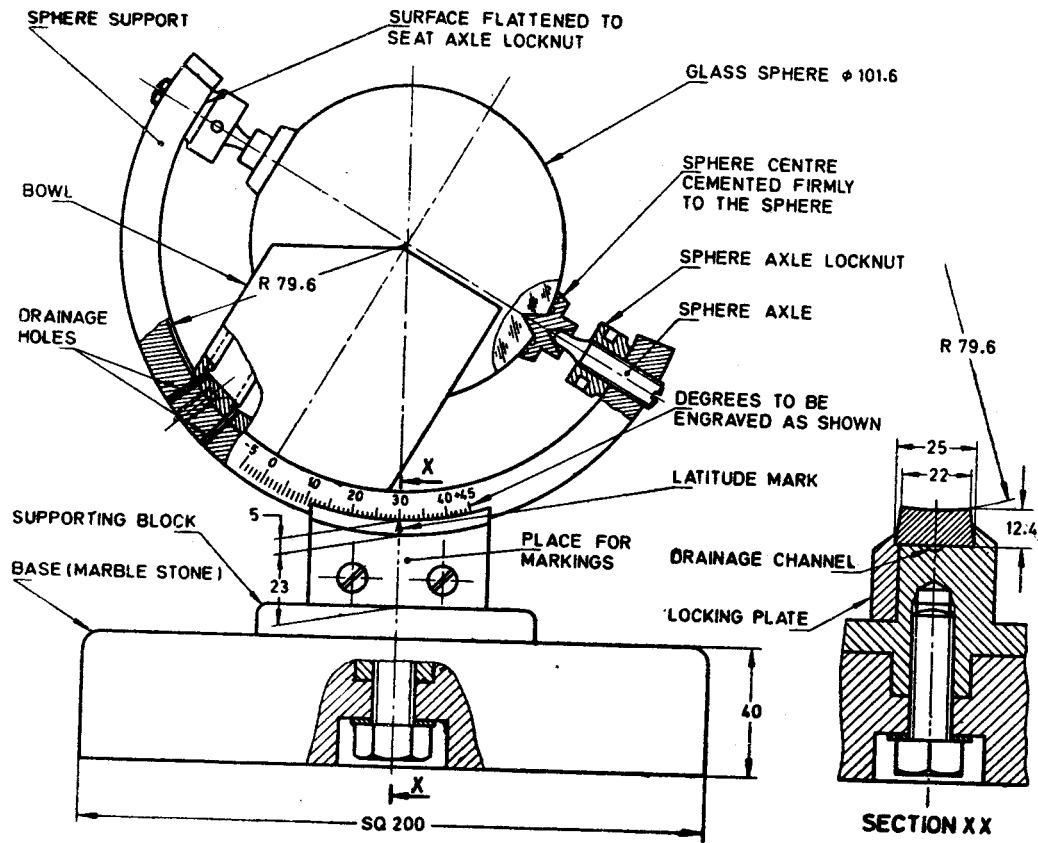
5. GENERAL REQUIREMENTS

5.1 Glass Sphere

5.1.1 The glass sphere shall be free from striations and surface defects.

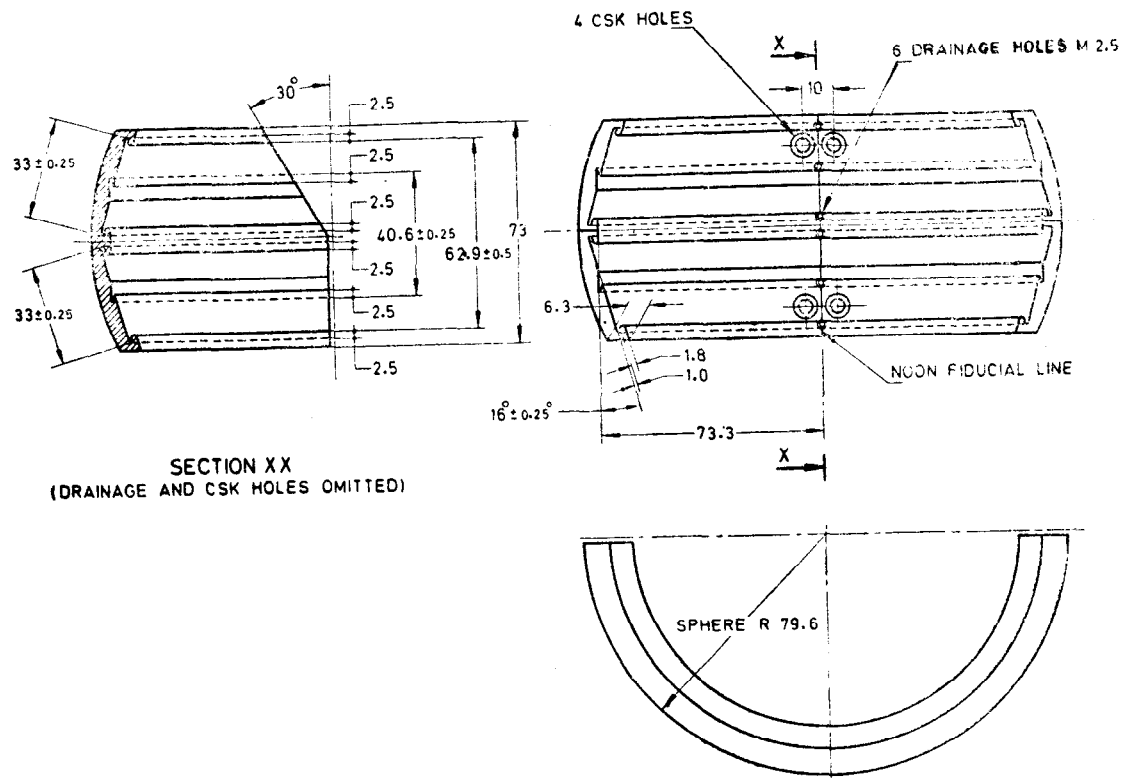
*Specification for tin bronze ingots and castings (*second revision*).

†Specification for brass rods for general engineering purposes.



All dimensions in millimetres.

FIG. 1 SUNSHINE RECORDER (LATITUDE 5°S TO 45°N)



All dimensions in millimetres.

FIG. 2 DIMENSIONS FOR BOWL FOR SUNSHINE RECORDER

5.1.2 It shall have a focal length of 74.9 ± 0.25 mm. This shall be determined as the mean of measurements along any four arbitrarily selected axes, none of which shall be nearer than 5° of arc to the axis of mounting of the sphere. The measurement of focal length at any single axis shall not be outside the range of 74.4 to 75.4 mm.

5.1.3 The correct diameter of a sphere for which the refractive index for sodium D light is 1.512 and of focal length 74.9 mm shall be 101.6 mm. To allow for variations of refractive index, the diameter shall be within 1.3 mm of the above value, subject to the requirement specified in **5.1.2** being satisfied.

5.1.4 No optical irregularity shall extend over the whole cross section of any cylinder of 25 mm diameter whose axis passes through the centre of the sphere.

NOTE — Optical irregularity is defined as an imperfection which prevents the formation of a sharp image with narrow pencils of parallel rays of sodium D light.

5.1.5 Two conical indentations, each 4.7 mm diameter with included angle of 60° , shall be ground in the sphere exactly diametrically opposite to each other.

5.2 Sphere Centres

5.2.1 Two brass sphere centres shall be firmly cemented to the glass sphere as indicated by the conical indentations on the sphere. The cement used shall be fully weather-proof.

5.2.2 It is most important that the sphere centre and its conical points shall all lie on the same axis, so that when mounted between centres, the eccentricity of the sphere shall not exceed 0.08 mm.

5.3 Base — The base shall be smooth and polished. It shall have a hole in the centre to take the bolt which fixes the supporting block to it.

5.4 Supporting Block — The supporting block shall be provided with a narrow drainage channel. It shall have two holes suitably threaded for clamping the sphere support to it by means of the locking plate.

5.5 Locking Plate — The locking plate shall securely lock the sphere support on the supporting block on tightening the two screws provided in front. It shall bear an index mark in the shape of an arrow engraved on it to indicate the correct setting for latitude. The mark shall be filled with a permanent black pigment.

5.6 Sphere Support

5.6.1 The front face of the sphere support shall have graduations of degrees of angle engraved neatly and legibly on it to indicate the latitudes -5° through 0° to $+45^\circ$. Figures of -5 , 0, 10, 20, 30, 40 and $+45$ shall be neatly and legibly engraved so that prolongation of appropriate

graduation marks pass through the visual and geometric centre of the complete figure. All graduations and figures shall be filled with permanent black pigment.

5.6.2 The spherical radius of the inner surface of the sphere support shall be the same as that of the outer surface of the bowl such that the latter sits on the former evenly.

5.6.3 The appropriate portions on the inner surface of the sphere support shall be suitably flattened to seat the locknut evenly.

5.6.4 The sphere support shall be attached symmetrically to the back of the bowl and shall be concentric with it. Two suitable holes shall be bored and threaded at both ends for taking the sphere axles.

5.6.5 The sphere support shall be provided with six drainage holes, corresponding to those in the bowl above it.

5.7 Bowl

5.7.1 The bowl shall have grooves of 1 mm inside depth to carry the cards. The inside diameter of the bowl measured along a line equidistant from its end faces shall be 146.6 ± 0.2 mm.

5.7.2 It shall consist of a belt cut from a suitable sphere symmetrically with respect to its diameter. The belt shall then be cut into two halves on a line at right angles to the end faces to produce two bowls. One pair of corresponding corners of each bowl shall be cut away at 30° to the previous cut. These two cuts shall meet on a line parallel to the end faces and equidistant from them.

5.7.3 The bowl shall have a central noon fiducial line across it at right angles to the end faces and equidistant from the cut faces.

5.7.4 Six drainage holes distributed along the central noon fiducial line shall be provided for draining off the water collecting in the grooves of the bowl.

6. WORKMANSHIP AND FINISH

6.1 The sphere shall be accurately centred in the bowl.

6.2 The sphere centres, cemented to the sphere support shall be such that the sphere can be inserted into the sphere support in any direction and have eccentricity within the limits specified in **5.2.2**.

6.3 The supporting block locking plate, sphere support with the sphere-axle locknut, sphere axle, etc, shall be polished and lacquered.

6.4 The bowl shall be oxidized and the stone base shall be polished smooth.

7. TESTS

7.1 With the sphere support set to read 0° on the latitude scale, the end faces of the bowl as well as the planes containing the card grooves shall be at right angles to the base and the supporting block. Similarly with the sphere support set to read 30° on the latitude scale, the plane of the 30° cut of the bowl shall be truly horizontal.

8. MARKING

8.1 The following shall be neatly and legibly engraved on the front face of the locking plate:

- a) Name of the instrument;
- b) Maker's name or registered trade-mark; and
- c) Serial number and year of manufacture, for example, No. 208/72.

8.1.1 The instrument may also be marked with the ISI Certification Mark.

NOTE— The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

9. PACKING

9.1 Each complete sunshine recorder with the sphere mounted in place shall be packed in a wooden box with a lining of felt at the base and with adequate cushioning material to ensure that the instrument is capable of withstanding normal transit risks without damage. Alternatively, the instrument shall be suitably packed as agreed to between the purchaser and the supplier.

10. TESTING AND INSPECTION

10.1 Each sunshine recorder shall be tested for conformity to all the requirements of this specification.

APPENDIX A

(Clause 4.2)

PROPERTIES AND DIMENSIONS OF SUNSHINE CARDS**A-0. GENERAL**

A-0.1 Since the burn of the card indicating bright sunshine depends as much on the correct design and adjustment of the instrument as on the type of card used with it, it is essential for comparison and correlation purposes that the sunshine cards used with the sunshine recorder should be of the same type and quality and have similar dimensions. The following requirements are, therefore, laid down for the sunshine cards.

A-1. MATERIAL

A-1.1 The cards shall be made from white pasteboard.

A-2. GENERAL REQUIREMENTS

A-2.1 The thickness of the board when dry shall not be less than 0.43 mm or greater than 0.48 mm. Cards of dimensions stated below cut from the pasteboard in such a manner that the length is down-board and the width across-board shall satisfy the following conditions:

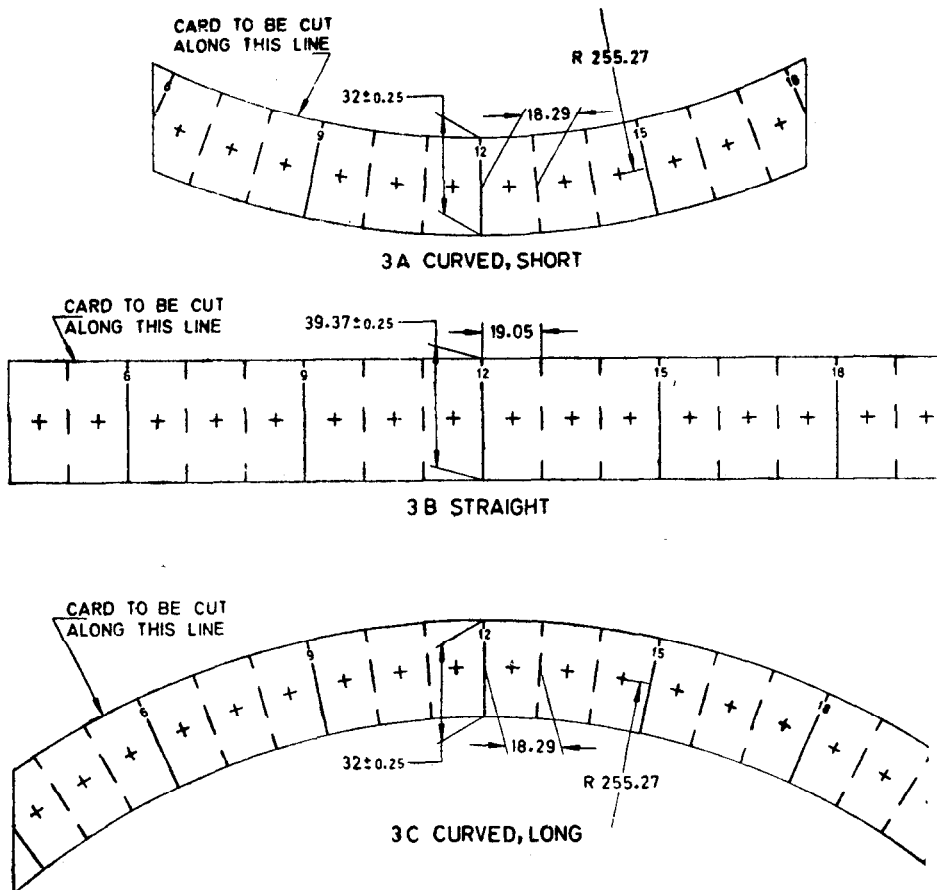
	<i>When Dry</i>	<i>After Immersion for 18 Hours in Water</i>	<i>On Redrying</i>
Length down-board, mm	127	127	Not less than 125.7
Width across-board, mm	25.4	Not more than 25.9	Not less than 25.1
Thickness, mm	0.43 to } 0.48 }	Not more than 0.76	

A-2.2 The pasteboard as well as a specified strip of the sunshine card shall resist, without tearing, the forces mentioned below when tested on the strength tester with a free length of 177.8 mm between the clampings. A length of card of thickness specified in **A-2.1** and of 16 mm width shall be used for the latter case:

	<i>When Dry</i>	<i>After Immersion for 18 Hours in Water</i>
Strength down-board	28.44 MPa (290 kgf/cm ²)	1.47 MPa (15 kgf/cm ²)
Strip of card 16 mm wide	222.6 N (22.7 kgf)	12.26 N (1.25 kgf)
Strength across-board	20.59 MPa (210 kgf/cm ²)	1.18 MPa (12 kgf/cm ²)
Strip of card 16 mm wide	166.6 N (17 kgf)	8.92 N (0.91 kgf)

A-3. TYPES OF CARDS

A-3.1 The cards shall be of three types, namely 'straight', 'curved, short' and 'curved, long' (see Fig. 3).



All dimensions in millimetres.

FIG. 3 DIMENSIONS FOR CARDS FOR SUNSHINE RECORDER

A-4. PRINTING

A-4.1 The upper surface of the board shall be coloured to a standard shade of the blue, namely colour No. 7-085 or 7-086 of IS : 1650-1960*

A-4.2 The length of each card shall be down-board and the width across-board.

A-4.3 The distance of any cross from one edge of the card shall not differ by more than 0.5 mm from its distance from the other edge.

A-4.4 For every curved card, the radius of the circular arc passing through the crosses shall be 255.27 mm and the time scale shall be 18.29 mm/h along this arc. For straight cards the time scale shall be 19.05 mm/h.

A-4.5 The width of the straight cards shall be 39.37 mm and that for the curved cards 32.0 mm.

A-5. CUTTING

A-5.1 The cards shall be cut individually.

A-6. SAMPLING AND TESTING

A-6.1 Sampling shall be in accordance with 3 of IS : 1060 (Part I)-1966† and samples shall conform to the requirements laid down in A-2 to A-4 above.

*Colours for building and decorative finishes.

†Method of sampling and test for paper and allied products, Part I (revised).



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